and self-induction into the circuit; (*b*) under a low potential difference by means of the discharge from a glowing lime cathode; and (*c*) by electromagnetic induction in the electrodeless ring discharge. Under these different conditions a continuous spectrum, a band spectrum, and spectra with various numbers of bright lines may be obtained. The difficulty is to correlate the observed spectra with the electrical conditions producing them.

The author gladly takes this opportunity of expressing his thanks to Prof. Sir J. J. Thomson for his interest in these experiments, which were carried out in the Cavendish Laboratory, Cambridge.

The Specific Heat of Water.

By W. R. Bousfield, M.A., K.C., and W. Eric Bousfield, B.A.

(Communicated by Prof. Sir J. Larmor, Sec. R.S.,—Received January 19,—
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(Abstract.)

The object of this investigation was to obtain a basis curve for the specific heat of water, for comparison with specific heat curves of aqueous solutions. Former observers using different methods have obtained widely varying curves; thus for the specific heat of water at 80° in terms of the 15° calorie, the following figures have been given, showing differences of 1 per cent.:—Barnes, 1·0014; Regnault, 1·0081; Lüdin, 1·0113.

For the value in joules of the 15° calorie the following have been found:—Joule, 4·174; Griffiths, 4·198; Barnes, 4·184.

The first part of our investigation is concerned with the determination of the mechanical equivalent of heat in terms of the mean calorie from 13° to 55°, by a method of continuous flow calorimetry. Mercury thermometers were used which could be read to 0°·005. An interval of 40° was taken, so that an error of 0°·01 would not vitiate the result by more than 1 in 4000. Through a Dewar vessel containing about 3 litres of water, in which was an electric heater, there was passed a current of water, entering at about 13° and passing out at about 55°. The vessel was immersed in a bath kept at the same temperature as the contents of the vessel. The top of the vessel was closed by a platinum box kept 10° higher.

The electric heater, and the resistance used in series with it for determining the current by help of a battery of standard cells, were of novel type. Each consisted of a spiral glass tube of small bore into the ends of which were sealed platinum electrodes. The tube is connected with a thermometer tube so that the spiral forms a thermometer bulb. By calibrating the resistance against the reading of this thermometer tube, the resistance is accurately known, even when a current is passing. This type of resistance enabled us to surmount a difficulty apparently never considered by previous investigators. We have found that when a heavy current passes through an ordinary standard resistance, the resistance of the standard depends not only on temperature but also upon strength of current. The passage of the current appears to induce a state of strain which temporarily alters the resistance by an amount which may be as much as several units in 10,000. The residual effect on the resistance when the current ceases has long ago been observed, particularly as a hysteresis effect with manganin resistances. The change which persists whilst the current is passing may be conveniently called the "thermoid" effect. We believe a liquid mercury resistance is free from any such effect.

The continuous-flow experiments gave for distilled water $J_{13}^{55} = 4{\cdot}182$. To get the curve for J from 0° to 80°, a weighed quantity of water was heated from 0° to 80° by stages which gave J_0^{13}, J_{13}^{27}, J_{27}^{55}, J_{55}^{80}, the mean specific heats over the intervals. For this purpose the capacity of the calorimeter was obtained from the value of J_{13}^{55}, previously determined, and a separate research on the specific heat of glass was carried out in order to obtain the variation of capacity with temperature. From these mean values of J for the intervals an equation for the value J_0^{θ} was obtained, and then the value of J from point to point from the equation

$$J = \frac{d}{d\theta}\,(\theta J_0^{\theta}).$$

We thus obtain $J = 4{\cdot}2085 - 0{\cdot}003022\theta + 0{\cdot}00007833\theta^2 - 0{\cdot}0000004900\theta^3$, which gives for the value of the 15° calorie 4·179. The resulting curve corresponds closely with that obtained by Lüdin by the method of mixtures, and differs considerably from that obtained by Barnes* by continuous flow with platinum thermometry. The values of J obtained by us are as follows:—

θ.	J.	θ.	J.	θ.	J.
0	4·209	30	4·175	60	4·203
5	4·195	35	4·178	65	4·208
10	4·186	40	4·182	70	4·213
15	4·179	45	4·187	75	4·216
20	4·176	50	4·192	80	4·217
25	4·174	55	4·198		

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[*] Barnes' latest values corrected for the value of the Clark cell used by him are given in 'Roy. Soc. Proc.,' 1909, A, vol. 82, p. 390.

The minimum value for the specific heat of water has been placed at various temperatures by different observers. Regnault found no minimum value; other observers have placed it as follows:—

Bartoli and Stracciati	20°	Rowland	30°
Lüdin	25°	Barnes	38°

Our value for the minimum agrees with that of Lüdin.

Memoir on the Theory of the Partitions of Numbers. Part V.—*Partitions in Two-dimensional Space.*

By Major P. A. MacMahon, D.Sc., F.R.S.

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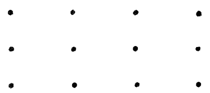
(Abstract.)

This paper is principally concerned with the enumerations of the partitions of numbers in two-dimensional space. Such partitions are such that the parts are placed at the points or nodes of a lattice, rectangular in shape, and



having given numbers of nodes in the sides, and the parts of the numbers partitioned are placed at the nodes in such wise that descending order of magnitude in each row of parts is from left to right and in each column of parts from top to bottom.

If the nodes in the sides be m, n, respectively, and the part magnitude be restricted so as to be not greater than l, the generating function which gives by the coefficients of x^w in the ascending expansion the number of such partitions of the number w has been long conjectured by the author to have the expression

$$\frac{\begin{array}{l}(l+1)(l+2)\ldots(l+m)\\ \qquad (l+2)\ldots(l+m+1)\\ \qquad\quad \ddots \qquad\quad \ddots\\ \qquad\qquad (l+n)\ldots(l+m+n-1)\end{array}}{\begin{array}{l}(1)(2)\ldots(m)\\ \quad (2)\ldots(m+1)\\ \quad\ \ \ddots \qquad \ddots\\ \qquad (n)\ldots(m+n-1)\end{array}}$$